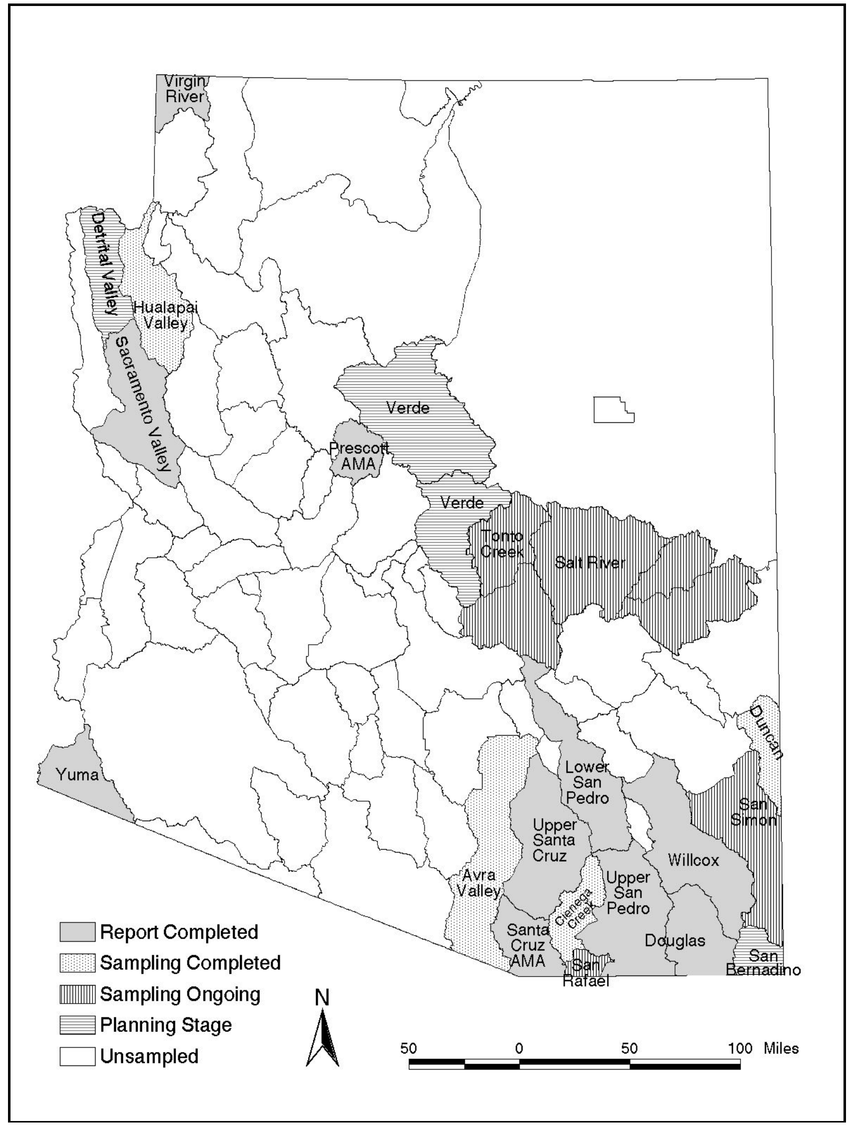
VI. Ground Water Quality: Out of Sight Not Out of Mind

How good is Arizona's ground water quality?

Most of Arizona's ground water meets aquifer water quality standards, and thus, is suitable for drinking water use. Ground water quality information by watershed is provided in tables, maps, and text in Volume II. A statewide overview is provided in this chapter.



How Does ADEQ Characterize Ground Water? – ADEQ's Ambient Ground Water Monitoring Program uses a statistically-based, comprehensive ground water monitoring approach to characterize regional water quality conditions. Wells are randomly selected within a ground water basin or other hydrologically defined area to support statistically valid assumptions during data interpretation. Using this method, a ground water basin is divided into monitoring "cells," the number of cells depends on the complexity of the watershed activities, hydrology, and geology. A suitable well is randomly selected and monitored in each cell to represent water quality for that area.

Since 1995, ADEQ has completed seven (7) ground water basin studies and has ongoing studies in eight (8) more basins **(Figure 25).** Brief summary reports for each of the basin studies are included Volume II, within the watershed studies. These studies are also reflected in the ground water monitoring maps. As these maps show, many areas have few if any wells monitored while areas where basin studies have occurred have many wells monitored.

After baseline water quality conditions have been determined, a few wells within the ground water basin are selected to represent ground water conditions for long-term trend analyses. These wells are monitored at a minimum of once every five years.

Index Wells and Targeted Monitoring -- Ground water data used in this assessment report was collected by multiple programs within ADEQ, US Geological Survey, the Salt River Project, and the Arizona Department of Water Resources (ADWR). This data does <u>not</u> include public drinking water samples collected by the facility as most of that data is collected after treatment and storage, and is frequently a mixture of well sources.The "targeted monitoring data" may be negatively biased, as investigations of ground water problems prompted the collection of at least some of this data. However, most wells sampled had acceptable quality water.

Two agencies, ADWR and ADEQ, collected the "index well" data. The distribution of index wells is related to the ground water monitoring methods used by each of the monitoring agencies. ADWR selects a small subset of wells to sample within each ground water basin across the state and monitors these wells annually. As already discussed, ADEQ conducts a comprehensive survey of a ground water basin based on a stratified random sampling of wells throughout the basin.

Data Analyses -- Ground water quality was evaluated in this report by:

- Illustrating statewide which index wells exceeded an aquifer water quality protection standard **(Figure 26)**;
- Illustrating within a watershed which wells exceeding a standard;
- Classifying general ground water quality within a watershed by looking at concentrations of:
  - Total dissolved solids, and
  - Nitrate.

For this assessment, the last five years (Oct 1995-Oct 2000) of ground water monitoring data stored in ADEQ's Water Quality Database were assessed. Statewide ground water monitoring data are summarized in **Table 28**. Constituents monitored were grouped into the following categories: radiochemical, fluoride, metals, nitrate, volatile organic chemicals (VOCs), semi-volatile organic chemicals (SVOCs), and pesticides. The "total number of wells" indicates how many wells were tested for each parametric group. Because wells are sampled for varying constituents, the "total number of wells" for each parametric group varies.

If a well exceeded a standard during the past five years for a parametric group, the well was counted as exceeding standards. However, this does not necessarily mean that the well water currently exceeds the standard.

All laboratory results reported as "less than" the detection level or "non-detection" were counted as in compliance with the standards.

Ground Water Standards – The Aquifer Water Quality Standards used in this assessment are shown in **Appendix C.** Generally these ground water standards are identical to the Safe Drinking Water Standards established for public water systems as well as surface water standards with the Domestic Water Source designated use.

Classifying Water Quality -- The concentration of some parameters in well water can be used to generally classify the quality of ground water in a region. The concentration of total dissolved solids (TDS) and nitrate in ground water are compared across each watershed in Volume II using the following classification systems.

- **Total Dissolved Solids –** The US Geological Survey classifies waters according to the following scale:

<500-999 mg/L	fresh
1000-2999 mg/L	slightly saline
3000-10,000 mg/L	moderately saline
>10,000 mg/L	very saline or briny

The US Environmental Protection Agency has set Secondary Maximum Contaminant Level (SMCL) for TDS at 500 mg/L due to the off-flavor drinking water has above this level. This is a guidance level, not a standard, and is not set due to a human-health concern but rather for aesthetic purposes.

For irrigation purposes, the Salt River Project's annual water quality report recognizes that salinity has effects on crop yield according to the following scale:

<500 mg/L	no problems with crop yield
500-2000 mg/L	increasing problems with crop yield
>2000 mg/L	severe problems with crop yield

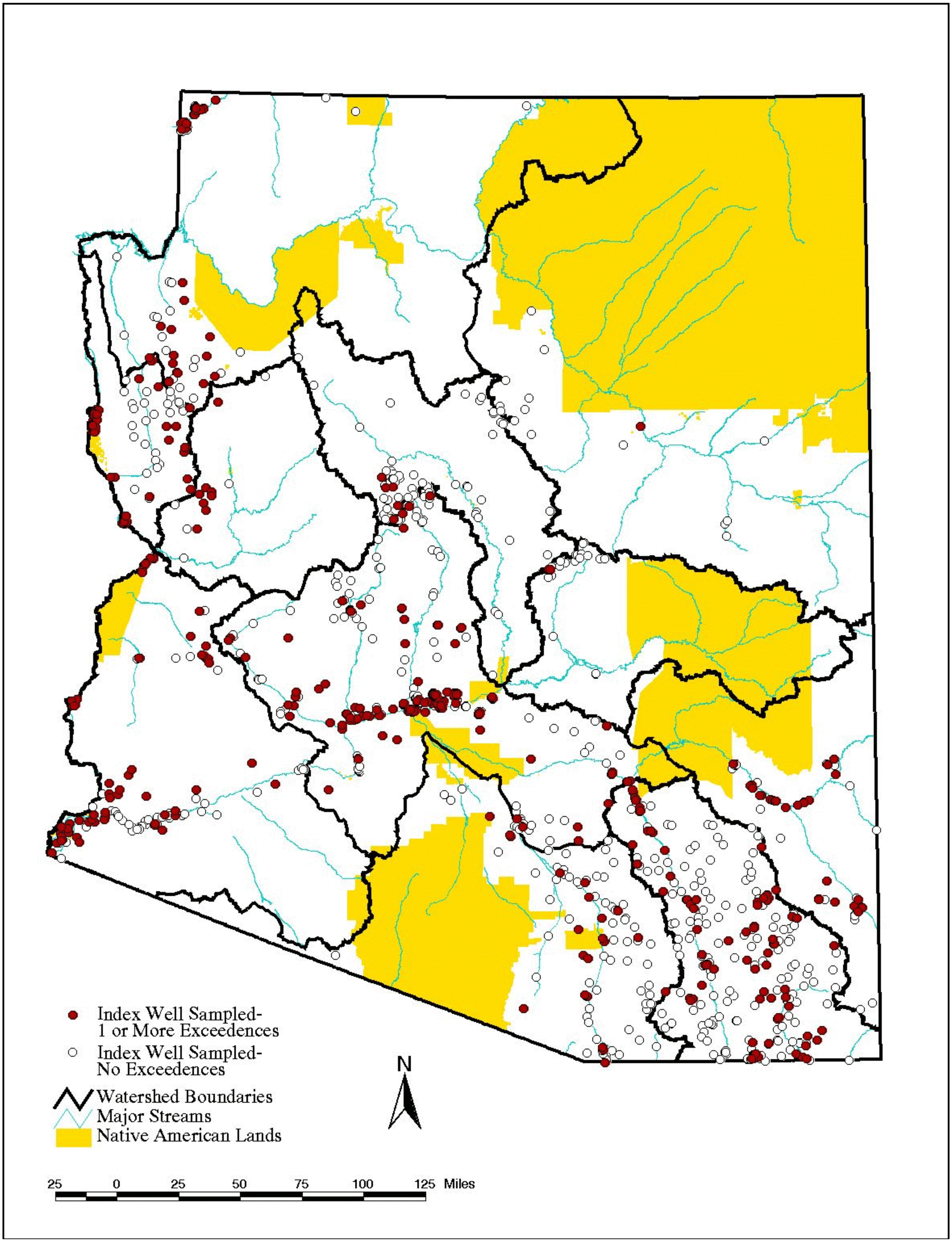
- **Nitrate** – In Arizona, nitrate in ground water are normally less than 3 mg/L. Occurrences of nitrate greater than 5 mg/L are frequently due to anthropogenic sources (historic agriculture practices, septic systems, and other sewage disposal practices). Drinking water containing nitrate above 10 mg/L should not be consumed by babies or nursing mothers; therefore, an aquifer water quality standard has been set at this level. Many of the wells exceeding the 10 mg/L nitrate standard were from shallow agricultural wells that are not currently used for drinking water purposes.

Table 28. Statewide Ground Water Monitoring – October 1995 to October 2000

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS			PERCENT OF WELLS EXCEEDING STANDARDS
		SAMPLED	SYNTHETIC CONSTITUENT DETECTED*	EXCEEDING STANDARDS	
INDEX WELLS	Radiochemicals	180		23	13%
	Fluoride	361		15	4%
	Metals/Metalloids	362		21	6%
	Nitrate	363		24	7%
	VOCs + SVOCs	165	10	0	0%
	Pesticides	166	0	0	0%
TARGETED MONITORING WELLS	Radiochemicals	97		9	9%
	Fluoride	522		68	13%
	Metals/metalloids	744		47	6%
	Nitrate	628		84	13%
	VOCs + SVOCs	559	267	182	32%
	Pesticides	458	5	0	0%

VOCs = volatile organic compounds; SVOCs = semi-volatile organic compounds.

*The detection of a synthetic constituent is noted because some pesticides, VOCs, and SVOCs do not have standards; however, these human-made substances are not naturally occurring in the ground water.


Index Well Sampled-
1 or More Exceedences
Index Well Sampled-
No Exceedences
Watershed Boundaries
Major Streams
Native American Lands
N
25 0 25 50 75 100 125 Miles

Do ground water and surface water contamination problems differ?

Pollutants --There are several pollutants that are of greater concern for ground water quality than surface water quality. These include volatile and semi-volatile organic compounds (VOCs and SVOCs), nitrate, fluoride, pesticides, petroleum hydrocarbons, and radiochemicals. Fluoride and radiochemicals are naturally occurring but have been detected at levels that exceed health-based standards. Nitrate and bacteria can be associated with both natural and anthropogenic sources. VOCs, SVOCs, hydrocarbons, and pesticides are synthetic compounds and detection of these human-derived compounds at any level in groundwater is cause for concern.

- **Volatile and semi-volatile organic compounds** have contaminated ground water in metropolitan areas of Arizona because of historic disposal practices for industrial solvents and dry-cleaning chemicals. High technology manufacturing facilities, such as electronics, aerospace, and military facilities, have used many solvents for several decades. Improper use and disposal practices have been documented for more than 50 years. Fortunately occasional surface spills seldom contaminate ground or surface water since these chemicals are volatile in nature.

- **Pesticide detections** in Arizona's ground water are rare but notable. Historic use of ethylene dibromide (EDB) and dibromo-chloropropane (DBCP) primarily in citrus groves resulted in detection of these compounds in ground water 20 years ago; however, these compounds are rarely detected today. Currently registered pesticides are formulated to volatilize or degrade into nontoxic by-products.
- **Petroleum hydrocarbons**, primarily originating from leaking underground storage tank sites, are a significant source of soil and ground water contamination in Arizona. These sites are found across the state, but are concentrated in the urban areas and along major transportation corridors.

- **Radioactive elements**, such as uranium, radon, and radium, occur naturally in the soil and water across Arizona. In some locations their concentrations are elevated above drinking water standards.

- **Nitrate and bacterial** contamination of ground water in Arizona are most frequently related to improper wastewater disposal and agricultural fertilizing practices, especially in areas with inadequate soils or shallow depth to groundwater. Poor well construction and seals can be a route for these pollutants to directly enter ground water. Most microorganisms are attenuated by passing through a few feet of soil; however, soil generally has no effect on slowing downward transport of nitrate.

Sources of Contaminants in Ground Water – Most groundwater contamination in Arizona has been due to historic practices and naturally occurring elevated levels of some parameters. ADEQ's Aquifer Protection Permit requirements, along with other state and federal permit requirements, have greatly reduced the chance of ground water contamination due to discharges. The protection of ground water from nonpoint sources is largely unregulated and dependent on voluntary application of Best Management Practices and efforts such as education and financial assistance programs.